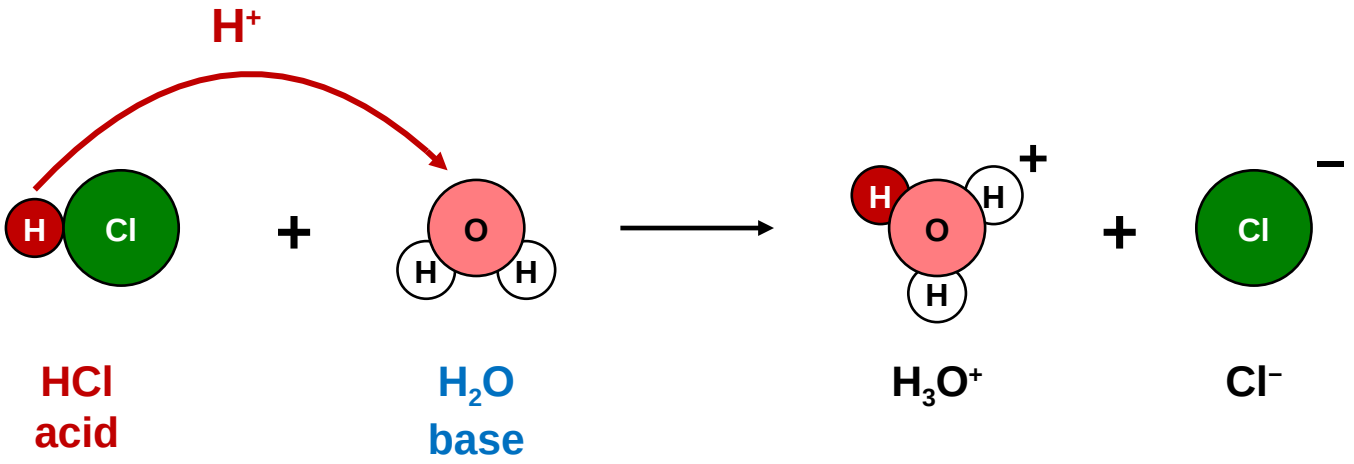
Essential Question

What does pH tell us about a solution?

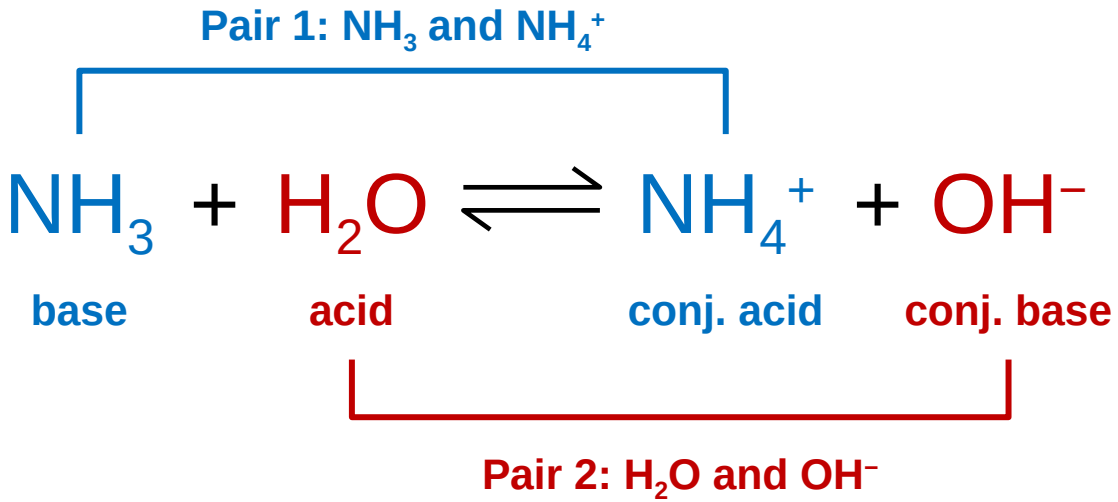
Brønsted-Lowry Acids and Bases

- Acid: donates H^+ (a proton)
- Base: accepts H^+



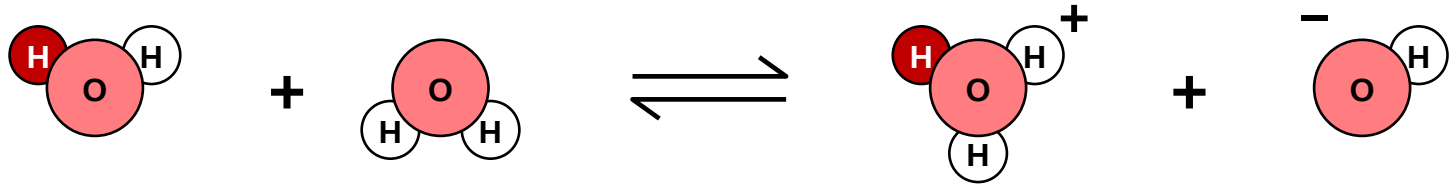
Conjugate Acid-Base Pairs

- Conjugates differ by one H^+



Water Autoionization

- Water reacts with itself
- One H_2O gives H^+ to another



H_2O acid + **H_2O base** ⇌ **H_3O^+** + **OH^-**

Only about 2 in every billion H_2O molecules ionize

The Water Constant

$$K_w = [H_3O^+][OH^-]$$

$[H_3O^+]$	$[OH^-]$	K_w
hydronium (M)	hydroxide (M)	1.0×10^{-14} at 25 °C

- Pure water: both are 1.0×10^{-7} M
- Tiny K_w: water barely ionizes

pH and pOH

$$pH = -\log[H_3O^+]$$

$$pOH = -\log[OH^-]$$

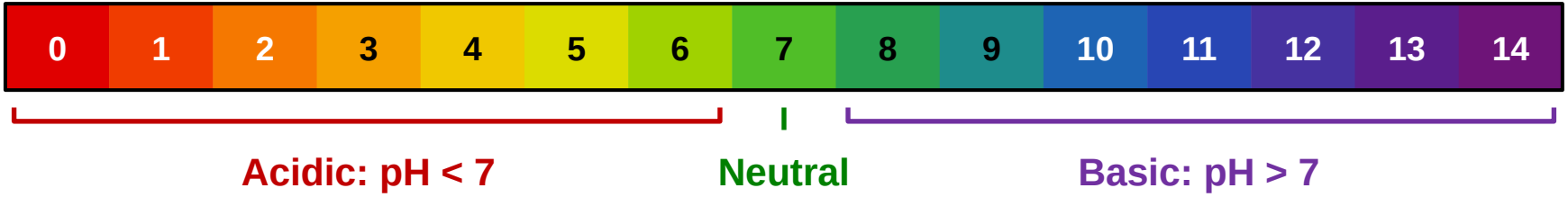
$[H_3O^+] = 1.0 \times 10^{-3}$ M → pH = 3.00

$[OH^-] = 1.0 \times 10^{-5}$ M → pOH = 5.00

- "p" means "take the −log of"
- More H_3O^+ → lower pH

The pH Scale

- Each pH unit = 10× change in $[H_3O^+]$
- Lower pH = more acidic

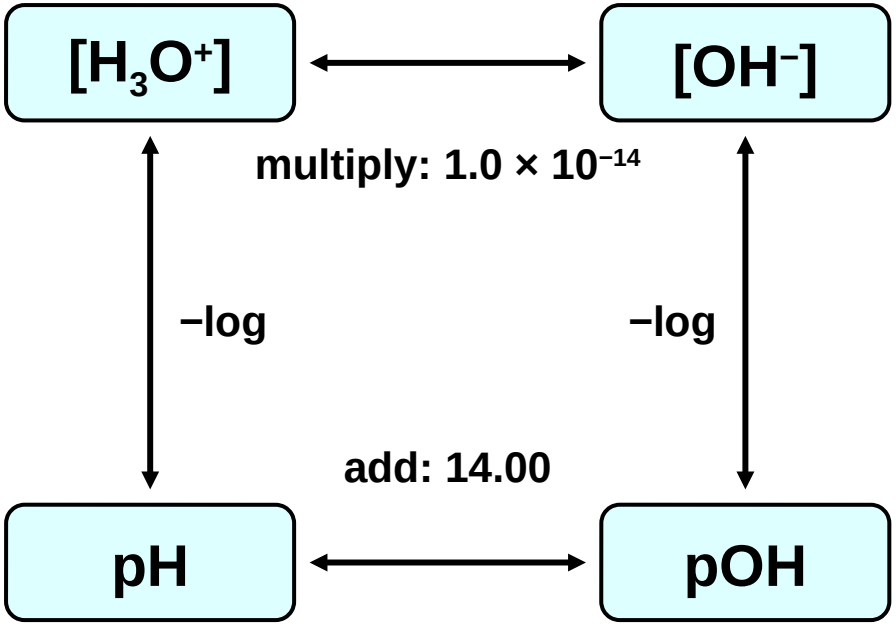


pH 3 has 10 × 10 = 100× more H_3O^+ than pH 5

pH + pOH = 14 (at 25 °C)

- Know one value, find the other three

$$pH + pOH = 14.00$$



Water Constant and Temperature

- Higher T → larger K_w
- Neutral: $[H_3O^+] = [OH^-]$
- Neutral pH is 7 only at 25 °C

T	K_w	Neutral pH
0 °C	1.14×10^{-15}	7.47
25 °C	1.0×10^{-14}	7.00
50 °C	5.5×10^{-14}	6.63

All three are neutral!

Example: pH and pOH

The $[H_3O^+]$ in a solution is 2.5×10^{-4} M at 25 °C. Calculate the pH and the pOH of the solution.



$[H_3O^+] = 2.5 \times 10^{-4}$ M

Example: Hydroxide from pH

A cleaning solution has a pH of 9.25 at 25 °C. Calculate the $[OH^-]$ in the solution.



pH = 9.25

Example: Pure Water at 50 °C

At 50 °C, $K_w = 5.5 \times 10^{-14}$. Calculate the pH of pure water at 50 °C. Is the water acidic, basic, or neutral?



Pure H_2O, 50 °C

Big Ideas

- $K_w = [H_3O^+][OH^-] = 1.0 \times 10^{-14}$
- pH = $-\log[H_3O^+]$; lower pH, more acidic
- Neutral means $[H_3O^+] = [OH^-]$

